PCT/GB 00/03615

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#2

INVESTOR IN PEOPLE

GB00/3615

The Patent Office
Concept House
Cardiff Road
Newport
South Wales
NP10 8QQ

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I, the undersigned, being an officer duly authorised in accordance with Section 74(1) and (4) of the Deregulation & Contracting Out Act 1994, to sign and issue certificates on behalf of the Comptroller-General, hereby certify that annexed hereto is a true copy of the documents as originally filed in connection with the patent application identified therein.

I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

In accordance with the Patents (Companies Re-registration) Rules 1982, if a company named in this certificate and any accompanying documents has re-registered under the Companies Act 1980 with the same name as that with which it was registered immediately before re-registration save for the substitution as, or inclusion as, the last part of the name of the words "public limited company" or their equivalents in Welsh, references to the name of the company in this certificate and any accompanying documents shall be treated as references to the name with which it is so re-registered.

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Dated 06 OCT 2000

THE PATENT OFFICE
21 SEP 1999
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Patents Form 1/77

Patents Act 1977
(Rule 16)

The Patent Office

1/77

Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

The Patent Office
21SEP99 E478219-1 C41069
P01/7700 0.00 - 9922247.3
Cardiff Road
Newport
Gwent NP9 1RH

1. Your reference STEERING PLOUGH.

2. Patent application number *(The Patent Office will fill in this part)* **9922247.3** 21 SEP 1999

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

THE ENGINEERING BUSINESS Ltd,
Broomhaugh House,
Riding Mill,
Northumberland. NE44 6EG.

Patents ADP number *(if you know it)* 7394240001

If the applicant is a corporate body, give the country/state of its incorporation UNITED KINGDOM.

4. Title of the invention

IMPROVEMENTS TO SUBMARINE PLOUGHS.

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

HARRISON GODDARD FOOTE
TOWER HOUSE
MERRION WAY
LEEDS LA2 8PA

Patents ADP number *(if you know it)* See F51/77

~~The Engineering Business Ltd,~~
~~Broomhaugh House,~~
~~Riding Mill,~~
~~Northumberland. NE44 6EG.~~

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicants named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES.

Patents Form 1/77

[redacted] Form 1/77

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	
Description	TWO/
Claim(s)	
Abstract	DML
Drawing(s)	FOUR?/

10. If you are also filing any of the following, state how many against each item.

Priority documents	
Translations of priority documents	
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	
Request for preliminary examination and search *(Patents Form 9/77)*	
Request for substantive examination *(Patents Form 10/77)*	
Any other documents *(please specify)*	

11. I/~~We~~ request the grant of a patent on the basis of this application.

Signature T.W. Cied Date 21-9-99.
Director.

12. Name and daytime telephone number of person to contact in the United Kingdom

Timothy Grinsted.
01434 682800

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

d) *If you have answered 'Yes' Patents Form 7/77 will need to be filed.*

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Patents Form 1/77

Improvements to Submarine Ploughs

This invention relates to submarine ploughs, particularly those for burial of cables and pipelines.

Hitherto, such ploughs have often been fitted with a steering system that operates by exerting transverse forces on the towing rope and thus generating couples on the plough that alter the direction of travel of the plough. Sometimes these ploughs are fitted with a mechanism to minimise the forces required as part of the steering of the plough. Such ploughs are described in patent EP 0185422. In some applications this mechanism can be lifted to transfer the tow rope attachment points to a position above the plough where the same rope can lift the plough in a level attitude.

This method of steering a plough has the disadvantage that the direction of travel of the plough is effected by changes in the tow rope direction together with any side forces, for example from side slopes that the plough may be traversing.

There are also known ploughs that steer by means of steerable fins attached to skids that support the front of the plough. Such a plough is shown in patent EP 0010915. This design overcomes the disadvantage of the first design in that the plough can be steered relative to the seabed, in a way more like a car steering works by angling the front wheels of the car. To minimise the steering forces required from the steerable fins on the skids, the tow rope is connected near the back of the plough or to a mechanism that gives the effect of towing from near the back (EP 0010915).

This method of steering has the disadvantage that without a force minimisation mechanism only small steering angles relative to the towrope are possible. Also the force minimisation mechanism necessary for larger angles of steering is often difficult to incorporate in the design of the plough because of the particular geometry required.

A further feature of these ploughs is the need for mechanism to pass over the top of the cable or pipeline, and this prevents or limits the ability to mount other equipment there, particularly if the tow points must be transferred to a lifting position.

According to this invention a plough that steers by the use of soil engaging fins that can be angled is provided with a mechanism to adjust the position of the tow rope attachment points so that the plough can operate at a range of offset tow position.

According to another aspect of this invention a plough according to the first aspect is provided with two separate mechanisms for adjusting position of the tow rope attachment points, one for each end of a two-rope tow bridle, these mechanisms being moveable independently or together from a towing position to a position where the towrope can be used to lift the plough in an approximately level attitude.

According to a third aspect of this invention a plough according to the previous aspects is provided with the soil-engaging fins required for steering fitted to skids that support the front of the plough, the skids having depth adjusting links connected to a beam that can pivot about a vertical axis from the plough chassis to provide angle changes for steering.

A specific embodiment of the invention will now be described by way of example with reference to the accompanying drawings:-
Figure 1 shows in elevation a typical plough in operating position in the seabed.
Figure 2 shows a plan view of the same plough.
Figure 3 shows a plan view of the same plough with the skids angled to steer the plough.
Figure 4 shows a plan view of the same plough with the towing mechanism moved to accommodate an offset tow position.
Figure 5 shows an elevation of the same plough with the tow rope in lifting position.
Figures 6 and 7 show plan views of ploughs fitted with alternative methods of steering the skids.

Referring to the figures 1 to 5, a seabed cable plough of a conventional type is made up of a chassis (1), a share (3), and support skids (2 and 4). The front skids (2) support the plough on the seabed (6) and the share (3) penetrates the seabed as the plough is towed by a ship (not shown) via towrope (5). The front skids (2) are adjustable hydraulically to set the trenching depth of the plough. Cable (7) enters the plough at bellmouth (12) and exits underground at the back of the plough (8). Rear skids (4) support the back of the plough when operating in very soft seabed soils. The plough may be fitted with a control and monitoring system and a hydraulic power pack, allowing the operators on the ship to operate it effectively.

Front skids (2) are fitted with soil penetrating fins (21) that generate side forces to steer the plough when they are angled as shown in figures 3, 6, and 7. The skids are angled by the action of hydraulic cylinders (22) in fig 3, (23) in fig 6 and (24) in fig 7.

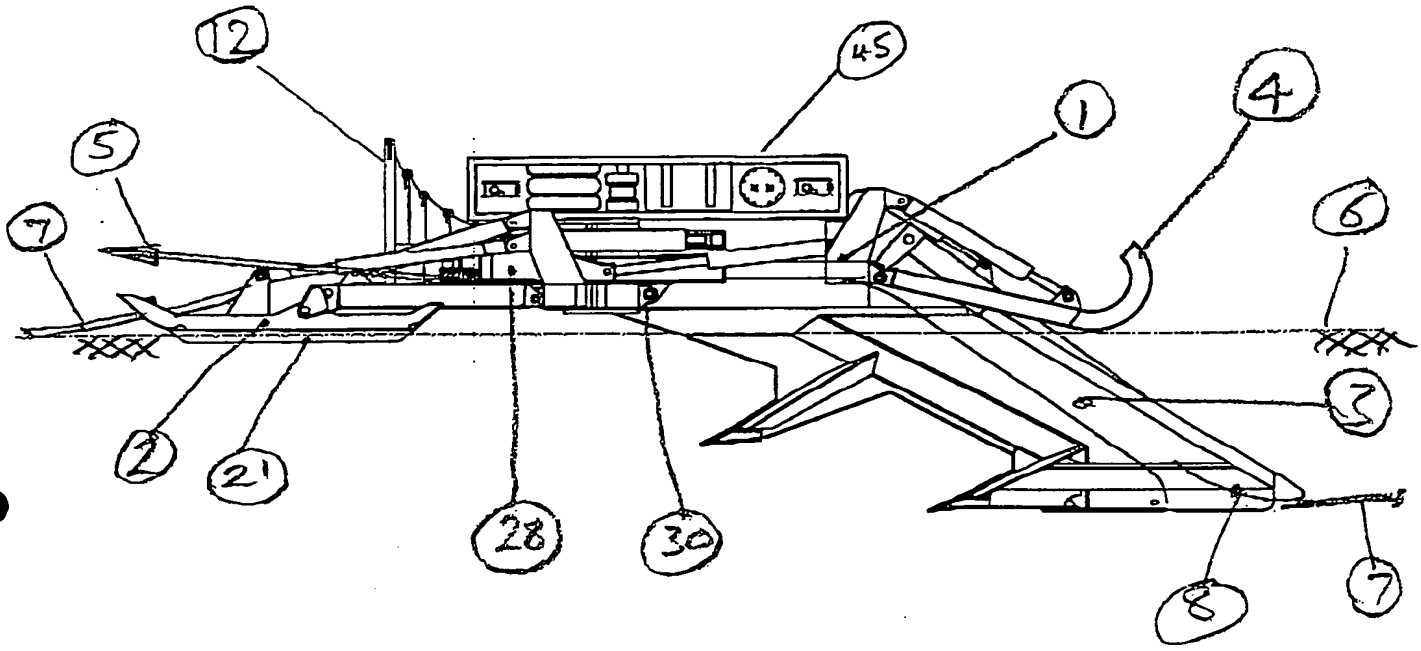
The tow rope (5) is connected to tow bridle (9) and this is connected to arms (25). These arms (25) can rotate about pivots (26) under the action of hydraulic cylinders (27). In figure 4 the arms (25) have been moved to accommodate the offset tow position of towrope (5) shown in figure 4. Steering can then take place by angling the skids (2) with fins (21) to allow the plough to follow the desired course on the seabed, or to allow for other side forces, for example from crossing a side slope. The arms can be moved to other positions to suit other offset tow positions on either side of the plough centreline.

The towrope adjusting mechanism formed by arm (25) and cylinder (27) is mounted on assembly (28) that is mounted pivotally from plough chassis (1) and is controlled by hydraulic cylinders (29). For normal operation the assembly (28) is positioned as shown in figures 1 and 2, and the plough is pulled along by the towrope (5). For lifting and lowering the plough to and from the seabed the hydraulic cylinders (29) can be operated to rotate assembly (28) about pivot (30) to the position shown in figure 5, where the tow wire can be used to lift the plough in an approximately horizontal position.

Figures 3, 6 and 7 show alternative ways of adjusting the angle of the skids to steer the plough. In figure 3 the two skids (2) with the adjusting linkage (42) and mounting beam (41) are pivotally mounted on chassis (1) at pivot (40). Cylinders (22) angle the beam (41) and hence the skids. In figure 6 the beam (41 in figure 3) is split to form two beams (44) in figure 6. Cylinders (23) rotate each beam independently to steer the plough about pivot (35). In figure 7 the cylinders (24) rotate only the skids (33) around pivot in the region of (36).

A benefit of having two pivoted structures for lifting the towrope is that the hydraulic and instrumentation package (45) can be located above the central cable route, thus lifting is higher on the machine. This helps to keep the framework and its contents out of the soil in very soft seabed conditions.

FIGURE 1



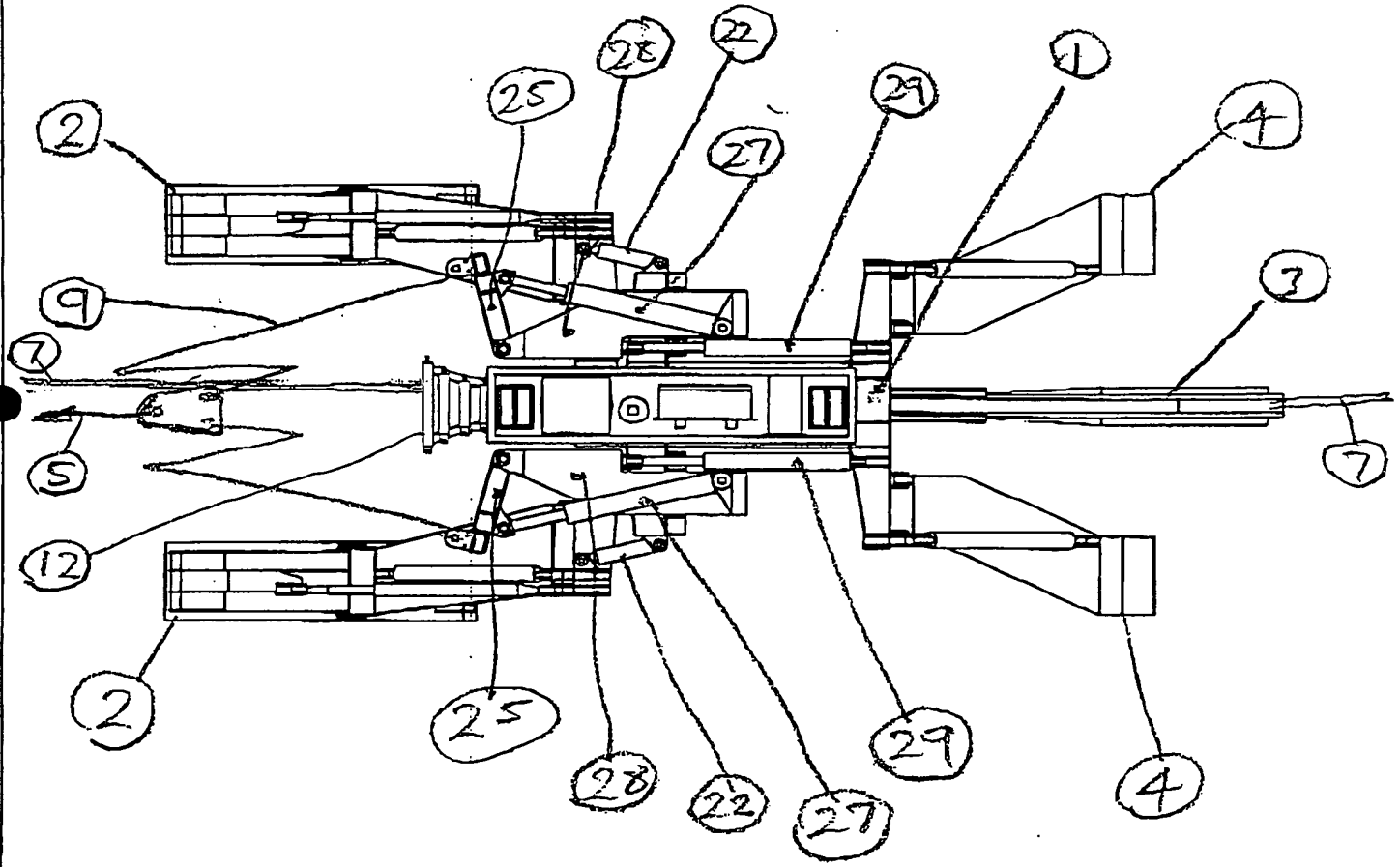


FIGURE 2

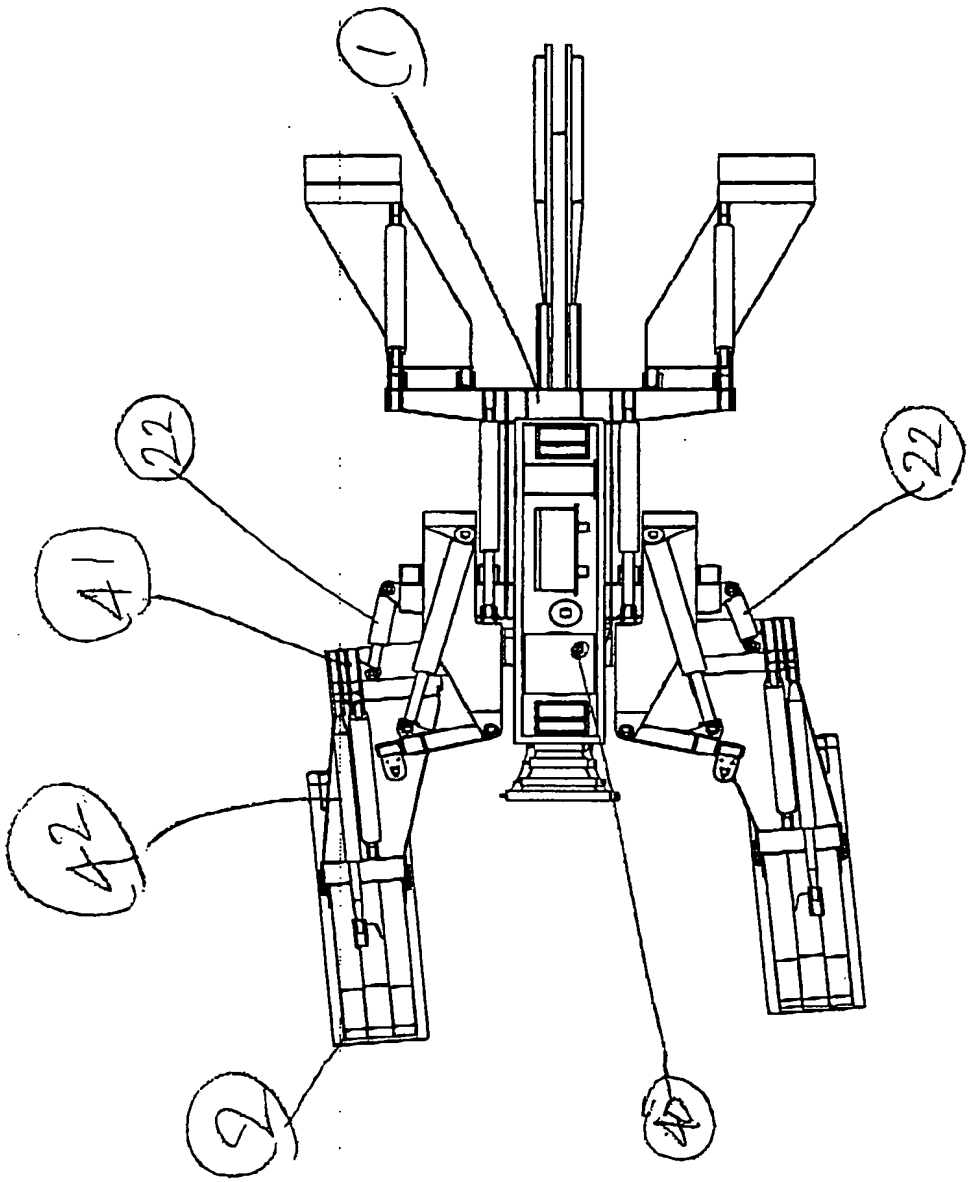


FIGURE 3

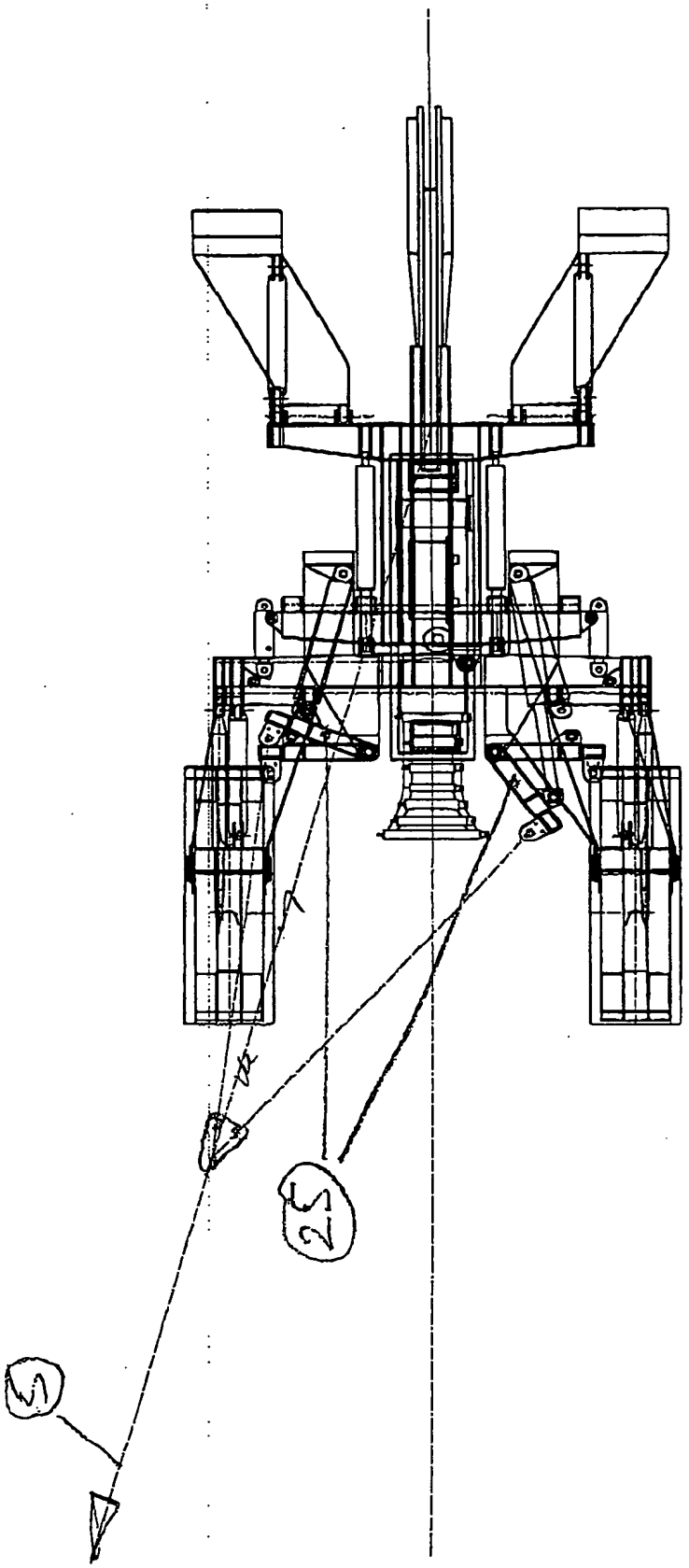


FIGURE 4

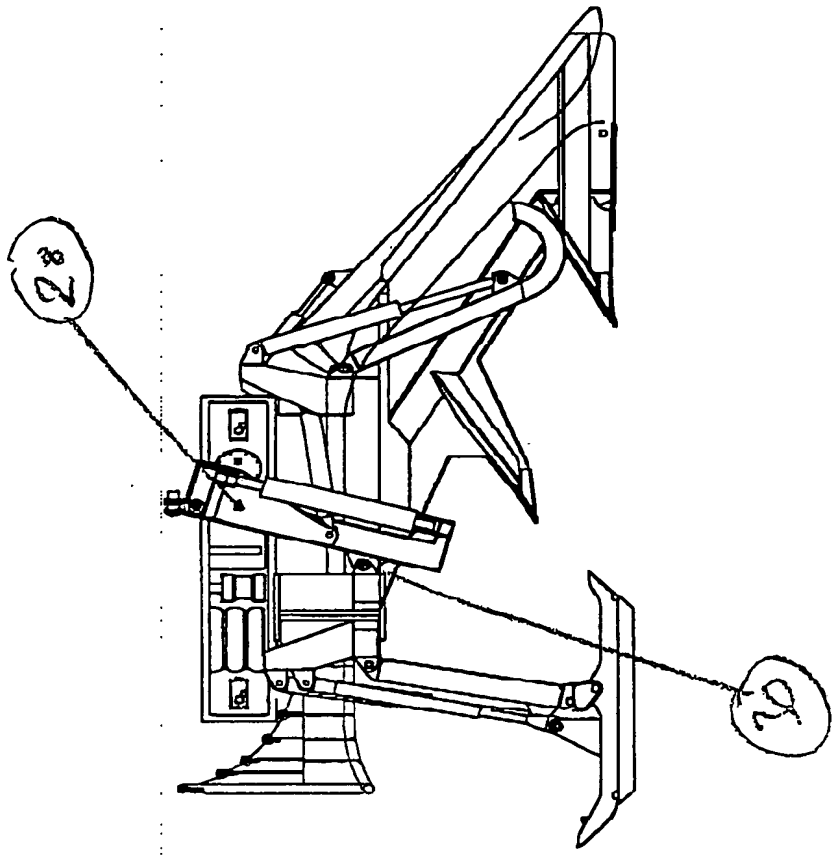
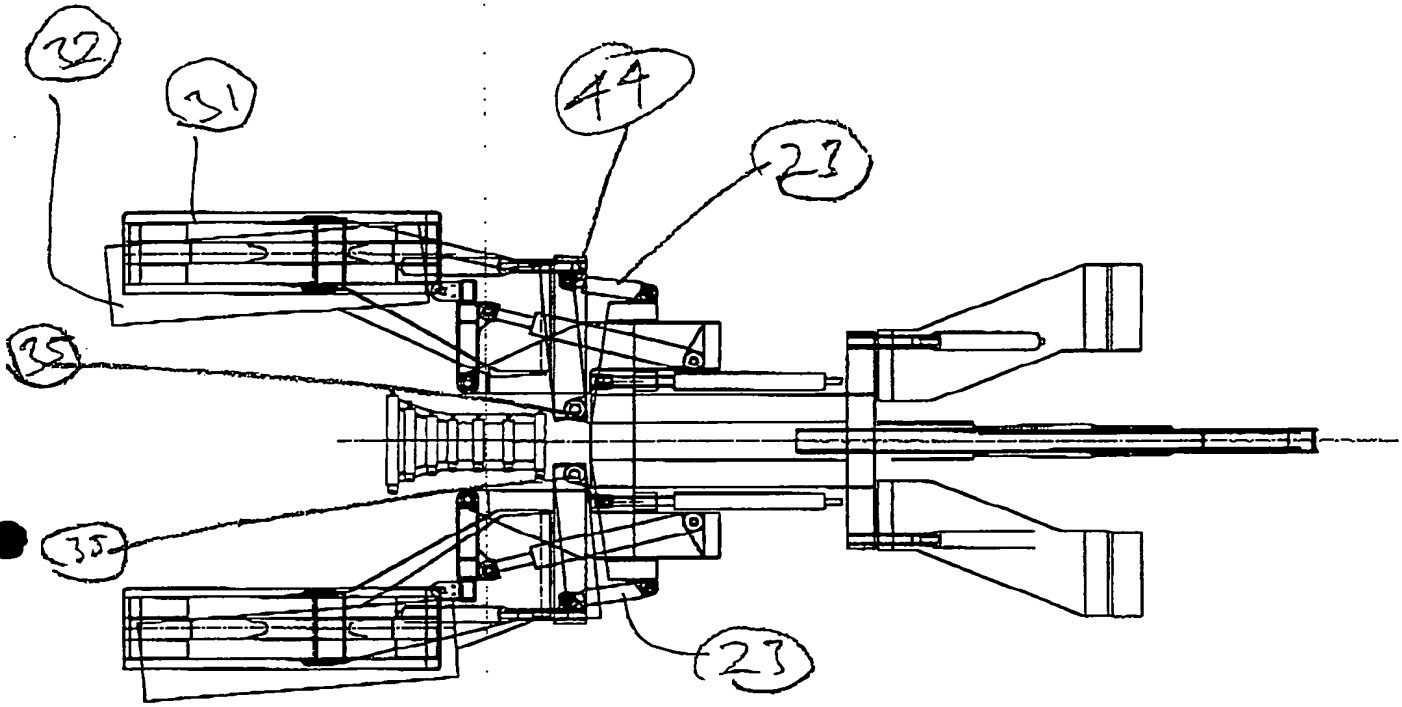
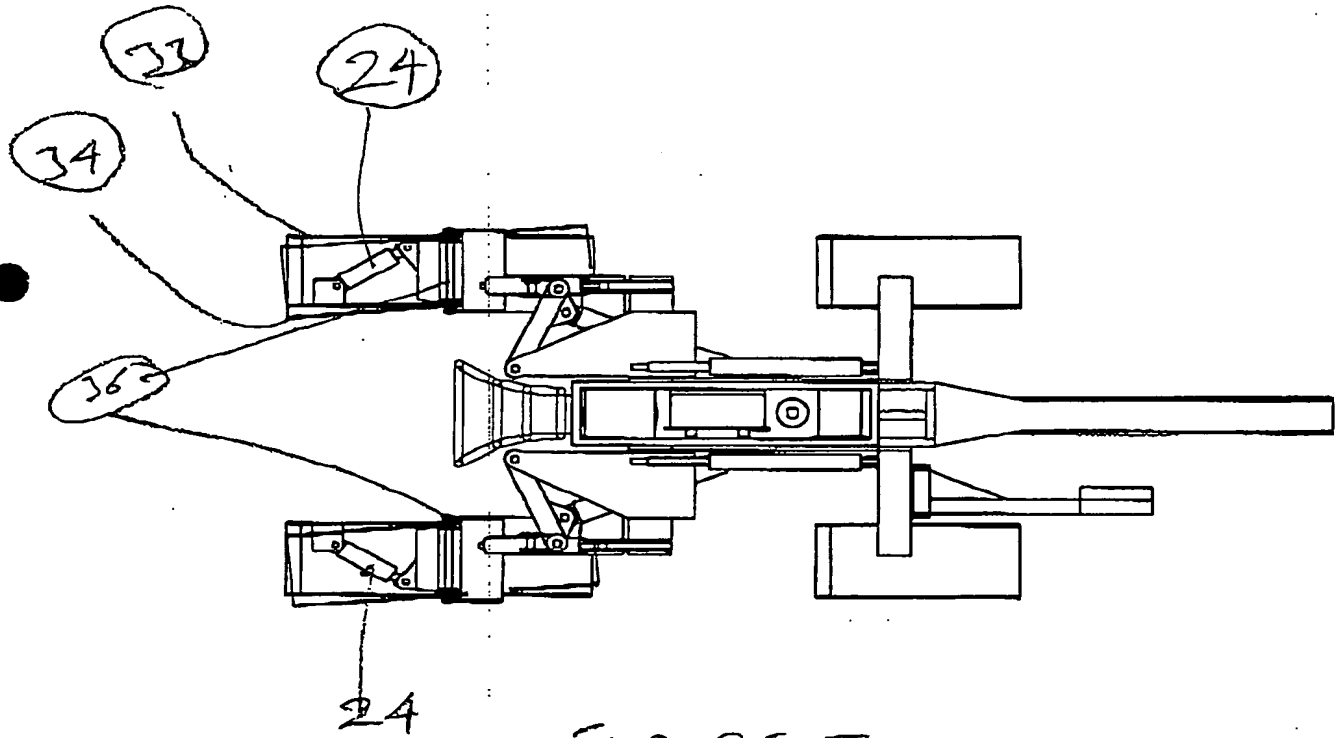


FIGURE 5

FIGURE 6





Steering Plough

FIGURE 7